

~~What is Claimed is:~~

~~SUP A~~ 1. A method for forming a mask assembly for use in lithography comprising the steps of:

5 forming a support structure that comprises a substrate that includes a plurality of windows filled with a temporary fill;

forming over the filled-windowed substrate a mask; and

removing the temporary fill.

10 2. The method of claim 1 wherein the mask comprises a membrane layer covered by a mask layer.

3. The method of claim 1 wherein the mask is a stencil mask.

15 4. A method for forming a mask assembly for use in lithography comprising the steps of:

forming a support structure that comprises a substrate that includes a plurality of windows filled with a temporary fill;

20 forming over the filled-windowed substrate a membrane layer for supporting the mask layer; and

25 forming a mask layer over the membrane layer;

and

removing the temporary fill.

5. The method of claim 4 in which the support structure is formed by the steps of:

30 forming in a substrate a first set of spaced apart windows;

filling the first set of windows with a temporary fill;

35 forming in the substrate a second set of windows located in portions of the substrate between the first set of filled windows; and

filling the second set of windows with a temporary fill.

6. The method of claim 5 in which the first partial set of windows is approximately one half of the total number of windows to be formed and the second set includes the remaining windows to be filled.

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7. The method of claim 6 in which the windows are in a two dimensional array of rows and columns and in which the first set consists of alternate windows in each row and column.

5 8. A method of forming a mask assembly comprising the steps of:

10 forming in a substrate a support structure, which includes major and minor struts that define an array of windows in a two-dimensional array of rows and columns, by successive rounds of cutting in the substrate a fraction of the total window area to be formed;

15 filling such fraction of windows with temporary fill before the succeeding round of cutting and filling until all the window areas are cut and filled;

20 forming a membrane layer over a top surface of the support structure;

25 forming a mask layer over the membrane layer; and

removing the fill from the windows.

9. The method of claim 8 in which the first round of cutting involves cutting approximately one half of the windows to be cut and a second round involves the remainder.

10. The method of claim 9 in which the first round of cutting is of alternate windows in each row and column.

11. The method of claim 4 in which the support structure is formed by the steps of:

15 placing in a mold which is shaped to facilitate the formation of a support structure a plurality of parallel minor struts; and

20 forming in the mold a support structure that comprises a frame and plurality of major struts that are orthogonal and attached to the minor struts with the major and minor struts defining a plurality of windows arranged in a two dimensional array of rows and columns.

25 12. The method of claim 11 further comprising the step of removing the support structure from the mold.

13. The method of claim 4 in which the forming over the filled-windowed substrate of the membrane and mask layers includes the steps of:

5 forming over a surface of a second substrate in turn a layer suitable for the mask and a layer suitable for the membrane;

bonding the membrane layer of the second substrate to the first-mentioned substrate in a manner to expose the second substrate, and

10 removing selectively the second substrate to expose the mask layer.

14. The method of claim 13 in which the second substrate is first implanted with ions to create in its interior an ion-implanted region and the second substrate is removed in part by cleaving along the ion-implanted region.

15. The method of claim 7 in which the forming over the filled-windowed substrate includes the steps of:

20 forming over a second substrate a mask layer and a membrane layer;

bonding the membrane layer to the filled-windowed substrate and leaving exposed the second substrate;

25 selectively removing the second substrate to expose the mask layer.

16. A method of forming a mask assembly for use in electron beam lithography comprising the steps of:

forming in a substrate a first set of spaced-apart windows;

30 filling the windows with a temporary fill;

forming in the substrate a second set of windows in the spaces between the first set of windows for forming with the first set a two-dimensional array of windows arranged in row and columns;

35 filling the second set of windows with a temporary fill;

depositing over the filled-windowed substrate a layer suitable for supporting a mask;

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depositing over the last-mentioned layer a
layer suitable for providing a mask;

5 patterning the last-mentioned layer to form a
mask, and

removing the temporary fill from the windows,
whereby the mask layer is free of underlying substrate.

10 17. The method of claim 16 in which the substrate
is chosen from the group consisting of aluminum oxide and
silicon carbide, the membrane is chosen from the group
consisting of silicon, silicon nitride, silicon carbide,
diamond, and aluminum oxide, and the mask is chosen from
the group consisting of tungsten and tantalum silicon
nitride.

15 18. The method of claim 16 in which the major
surfaces of the filled-windowed substrate are planarized
and made parallel before the deposition of the membrane
layer.

20 19. The method of claim 4 in which the mask support
structure is formed by the steps of:
forming in a substrate a set of windows spaced
apart by major strut portions of the substrate;
forming a plurality of spaced apart grooves in
the major strut portions of the substrate; and
placing one of a plurality of minor strut
25 elongated strips in each of grooves.

20 20. A method for forming a mask assembly comprising
the steps of:
forming by use of a mold a support structure
that defines an array of windows arranged in rows and
30 columns;
filling the openings with a temporary fill;
forming over the support structure a membrane
layer;
35 forming over the membrane layer a patterned
mask; and
removing the temporary fill.

21. The method of claim 20 wherein the support
structure comprises major struts which are orthogonal to

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minor struts with the minor struts being placed in the mold prior to forming of the major struts and a frame which supports the major and minor struts.

5 22. A method of forming a mask support structure comprising the steps of:

forming in a substrate a first set of spaced apart windows;

filling the first set of windows with a temporary fill;

10 forming in the substrate a second set of windows located in portions of the substrate between the first set of filled windows; and

filling the second set of windows with a temporary fill.

15 23. A method of forming a mask support structure comprising the steps of:

placing in a mold which is shaped to facilitate the formation of a support structure a plurality of parallel minor struts;

20 forming in the mold a mask support structure that comprises a frame and plurality of major struts that are orthogonal and attached to the minor struts with the major and minor struts defining a plurality of windows arranged in a two dimensional array of rows and columns; and

25 filling the windows with a temporary fill.

24. The mask assembly formed by the method of claim

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25. The mask assembly formed by the method of claim

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17. 42. The mask assembly formed by the method of claim
18. 43. The mask assembly formed by the method of claim
25 44. The mask assembly formed by the method of claim
19. 45. The mask support structure formed by the method
20. of claim 22.
30 21 46. The mask support structure formed by the method
of claim 23.